QUESTION 1

1. The cost of a spanning tree is the product of the costs of the edges in the tree.

   True

   False

10 points

QUESTION 2

1. Let T be MST of G, and let A Í T be subtree of T.
   Let (u,v) be min-weight edge connecting A to V-A.
   Then (u,v) does not belong to T

   True

   False

10 points

QUESTION 3

1. MSTs satisfy the optimal substructure property: an optimal tree is composed of optimal subtrees.

   True

   False

10 points

QUESTION 4

1. Minimum Spanning Tree can be used by an electricity provider to minimize the total length of wire connecting the customers.

   True

   False

10 points

QUESTION 5

1. Single Source Shortest Path problem finding the minimum-weight path from a given source vertex s to another vertex v of a given Graph G.

   True

   False

10 points

QUESTION 6

1. Shortest paths do not satisfy the triangle inequality: weight(u,v) <= weight(u,x) + weight(x,v)

   True

   False

10 points

QUESTION 7

1. The running time of Bellman Ford algorithm is O(V^2*E).

   True

   False

10 points

QUESTION 8

1. Prim's algorithm solves the single source shortest path problem.

   True

   False

10 points

QUESTION 9

1. Bellman Ford algorithm is a Dynamic Programming solution to Single Source Shortest Path problem.

   True

   False

10 points

QUESTION 10

1. Dijkstra's algorithm is a solution to the Minimum Spanning Tree problem in graph theory.

   True

   False

10 points

QUESTION 11

1. Dijkstra's algorithm works on both directed and undirected graphs. However, all edges must have nonnegative weights.

   True

   False

10 points

QUESTION 12

1. The transition function makes the automaton deterministic. At each moment in time, the machine has exact instructions as to what will happen next.

   True

   False

10 points

QUESTION 13

1. Kruskal algorithm is a Dynamic Programming approach to solve the Single Source Shortest Path problem.

   True

   False

10 points

QUESTION 14

1. The last-occurrence function can be computed in time O(m^2 + s), where m is the size of P and s is the size of S

   True

   False

10 points

QUESTION 15

1. The worst case may occur in images and DNA sequences but is unlikely in English text Boyer-Moore's algorithm is significantly faster than the brute-force algorithm on English text

   True

   False

10 points

QUESTION 16

1. Thus, KMP's algorithm runs in optimal time O(m^2 + n)

   True

   False

10 points

QUESTION 17

1. If capacities are all integer, then each augmenting path raises |f| by ≥ 0

   True

   False

10 points

QUESTION 18

1. Note that this running time is polynomial in input size. It depends on |f*|, which is not a function of |V| or |E|.

   True

   False

10 points

QUESTION 19

1. Problems in NP may not be in P.

   True

   False

10 points

QUESTION 20

1. NP-complete: Collection Z of problems is NP-complete if (a) it is NP and (b) if polynomial-time algorithm existed for solving problems in Z, then P=NP.

   True

   False

ANOTHER EXAM

QUESTION 1

1. The generic uniprocessor random-access machine (RAM) assumes

All memory equally expensive to access

concurrent operations

All reasonable instructions take unit time

Constant byte size

10 points

QUESTION 2

1. Using the definition of θ, find C_1,C_2, and n_0 in the following:

4n^6-2n^2+n ∈θ(n^6)

Solution: C_1=7, C_2=3, n_0=1

True

False

10 points

QUESTION 3

1. Insertion sort algorithm:

An in-place sorting algorithm

is O(n log n) worst case

is not an in-place sorting algorithm

10 points

QUESTION 4

1. Give the recurrence and the worst-case running time using O-notation, of the Merge sort algorithm

T(n)= 2T(n/2) + n = O(n log n)

T(n)= T(n-1) + n = O(n^2)

T(n)= T(n/2) + 1 = O(log n)

10 points

QUESTION 5

1. Give the recurrence and the worst-case running time using O-notation, of the QuickSort algorithm

T(n)= 3T(n/3) + n = O(n log n)

T(n)= T(n-1) + n = O(n^2)

T(n)= T(n/2) + 1 = O(log n)

10 points

QUESTION 6

1. Consider a variation of MergeSort which divides the list of elements into two lists of size 1/3 and 2/3, recursively at each step, instead of dividing it into halves. The Merge procedure does not change.
   The recurrence relation for this algorithm is:

   T(n)= T(n/2) + T(3n/2) + n

   T(n)= T(n/3) + 2T(n/3) + n

   T(n)= T(n/3) + T(2n/3) +n

   T(n)= T(2n/3) + T(n/3) +n^2

10 points

QUESTION 7

1. The Solution of the following recurrence (T(n) =4T(n/4) + 5 log^2(n))
   using the Master theorem is:

   Case 1: T(n) = θ(n)

   True
   False

10 points

QUESTION 8

1. The solution of the recurrence (T(n) =9T(n/3) + 3n^2) using the Master theorem is
   Case 3 à T(n) = θ(log n)

   True
   False

10 points

QUESTION 9

1. Dynamic Programming breaks up a problem into two sub-problems, solve each sub-problem independently, and combine solution to sub-problems to form solution to original problem.

   True
   False

10 points

QUESTION 10

1. Dynamic Programming is a Top-down approach.

   True
   False

10 points

QUESTION 11

1. In Dynamic programming, we solve the same subproblem once?

   True
   False

10 points

QUESTION 12

1. The solution of the subproblems used within the optimal solution to the problem must themselves be optimal by cut-and-paste technique.

   True

   False

10 points

QUESTION 13

1. Dynamic Programming is used, when the solution can be recursively described in terms of solutions to subproblems (optimal substructure).

   True

   False

10 points

QUESTION 14

1. Dynamic Programming breaks up a problem into a series of overlapping sub-problems, and build up solutions to larger and larger sub-problems.

   True

   False

10 points

QUESTION 15

1. The output of Knapsack problem is a set of items S such that the sum of weights of items in S is at most K
   and the sum of values of items in S is maximized.

   True

   False

10 points

QUESTION 16

1. The Dynamic Programming solution of Matrix Chain Multiplication consists in counting the number of parenthesizations by exhaustively checking all possible parenthesizations.

   True

   False

10 points

QUESTION 17

1. The Dynamic Programming approach of Knapsack problem defines P(i,w) as the problem of choosing a set of objects from the first i objects that minimizes value subject to weight constraint of w.

   True

   False

10 points

QUESTION 18

1. Dynamic Programming of Knapsack problem relies on the following:
   V(i,w) = max (V(i-1,w-wi) + vi, V(i-1, w))
   A maximal solution for P(i,w) either uses item i (first term in max) or does NOT use item i (second term in max)
   V(0,w) = 0 (no items to choose from)
   V(i,0) = 0 (no weight allowed)

   True

   False

10 points

QUESTION 19

1. "Always pick the shortest ride available at the time" can be a greedy solution to the Activity Selection problem.

   True

   False

10 points

QUESTION 20

1. The following steps represent a Greedy solution to the Activity Selection problem:
   - Sort the activities by finish time
   - Schedule the first activity
   - Then schedule the next activity in sorted list which starts after previous activity finishes
   Repeat until no more activities

   True

   False

10 points

QUESTION 21

1. The optimal solution to the fractional knapsack problem can be found with a greedy algorithm.

   True

   False

10 points

QUESTION 22

1. The optimal solution to the 0-1 problem can be found with the same greedy strategy for the fractional knapsack problem.

   True

   False

10 points

QUESTION 23

1. If we remove item j from the load, then the remaining load must be the most valuable load weighing at most W - wj that thief could take from museum, excluding item j.

   True

   False

10 points

QUESTION 24

1. Dynamic Programming breaks up a problem into a series of overlapping sub-problems, and build up solutions to larger and larger sub-problems.

   True

   False

10 points

QUESTION 25

1. The output of Knapsack problem is a set of items S such that the sum of weights of items in S is at most K
   and the sum of values of items in S is maximized.

   True

   False

10 points

QUESTION 26

1. The Dynamic Programming solution of Matrix Chain Multiplication consists in counting the number of parenthesizations by exhaustively checking all possible parenthesizations.

   True

   False

10 points

QUESTION 27

1. The Dynamic Programming approach of Knapsack problem defines P(i,w) as the problem of choosing a set of objects from the first i objects that minimizes value subject to weight constraint of w.

   True

   False

10 points

QUESTION 28

1. Dynamic Programming of Knapsack problem relies on the following:
   V(i,w) = max (V(i-1,w-wi) + vi, V(i-1, w))
   A maximal solution for P(i,w) either uses item i (first term in max) or does NOT use item i (second term in max)
   V(0,w) = 0 (no items to choose from)
   V(i,0) = 0 (no weight allowed)

   True

   False

10 points

QUESTION 29

1. A connected graph does not have a path from every vertex to every other

   True

   False

10 points

QUESTION 30

1. In an undirected graph, Edge (u,v) = edge (v,u)

True

False

10 points

QUESTION 31

1. The adjacency matrix requires O(V^2) storage space.

True

False

10 points

QUESTION 32

1. For undirected graph the adjacency matrix is symmetric.

True

False

10 points

QUESTION 33

1. The minimum amount of storage needed by an adjacency matrix representation of an undirected graph with 4 vertices is 8 bits.

True

False

10 points

QUESTION 34

1. Adjacency list is often a more appropriate representation for sparse graphs.

True

False

10 points

QUESTION 35

1. Breadth-first search strategy for exploring a graph can be summarized as follows:
   - Explore "deeper" in the graph whenever possible.
   - Edges are explored out of the most recently discovered vertex v that still has unexplored edges.
   - When all of v's edges have been explored, backtrack to the vertex from which v was discovered.

True

False